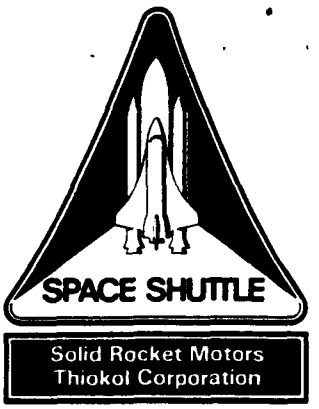
NASA-CR-183898




TWR-60028

# M-120 ALUMINUM FEEDER INVESTIGATION

## FINAL REPORT

JANUARY 1990

**Prepared for:**

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**
**GEORGE C. MARSHALL SPACE FLIGHT CENTER**
**MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812**

**Contract No.** NAS8-30490

**DR. No.** TYPE 5-3

**WBS.No.** 4B 201

*Thiokol* CORPORATION
*SPACE OPERATIONS*

*P.O. Box 707, Brigham City, UT 84302-0707 (801) 863-3511*

DOC NO. TWR-60028 VOL REV

TITLE PEI-989

# M-120 ALUMINUM FEEDER INVESTIGATION

## FINAL REPORT

JANUARY 1990

PREPARED BY:

R. F. Brown

R. F. BROWN
MIXING & CASTING PROCESSING

APPROVED BY:

J. M. Jewell 2/14/90

J. M. JEWELL, SUPERVISOR
MIXING & CASTING PROCESSING

T. F. Christensen 2/14/90

T. F. CHRISTENSEN, MANAGER
PROCESS ENGINEERING

J. H. Stoker

J. H. STOKER
SYSTEMS INTEGRATION

Gary Dixon

G. W. DIXON
SRM PROGRAM MANAGER

K. R. McArthur

K. R. MCARTHUR
FACILITIES ENGINEERING

G. D. Godfrey

G. GODFREY
MANUFACTURING ENGINEERING

L. D. Andersen

L. D. ANDERSEN
MIXING & CASTING PROCESSING

Dave L. Countryman

D. L. COUNTRYMAN
MIXING & CASTING PROCESSING

Ron Larsen 6-27-90

SYSTEM SAFETY


Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, UT 84302-0707 (801) 863-3511


I. N. Black

I. N. BLACK
TEST PLANNING AND REPORTING

P C Tydeck 2-27-90

RELEASE
ECS NO. SS 3854

## CONTENTS



Process Engineering Technical Report Categories

Aluminum Powder
Premix
Solids Feeders
Weigh Scales
Vibration

## 1.0 INTRODUCTION AND SUMMARY

One step in the RSRM propellant manufacturing process is to weigh and blend aluminum powder with HB polymer at the premix facility (M-120). Recently, difficulties have been experienced in maintaining the aluminum powder delivered weights within tolerance.

Process Engineering assisted Facilities Engineering, Manufacturing Engineering, and Manufacturing in evaluating the aluminum powder weighup system. Several deficiencies were noted and corrected as follows:

1. Vendor personnel "retuned" the Carrier vibrating screener which was vibrating excessively.

2. A re-built Parametrics variable frequency drive was installed which allowed for better control of the screener's drive motor.

3. An additional air vent area was provided on the weigh hopper which eliminated any reverse airflow.

Once these items had been incorporated, 20 consecutive weighups were conducted on 22 December 1989 without any of the weighments exceeding the ± two pound tolerance limit.

While this was an improvement over the previous system, there are still additional areas of concern; mainly the controls and control console. The present equipment cannot be classed as "user friendly" and requires excessive operator involvement for accurate weighups. The controls need to be replaced by more modern equipment.

## 2.0 CONCLUSIONS

1. The Carrier vibrating screener being seriously out of tune will preclude accurate weighups.

2. Excessive vibrating induced by the Carrier screener causes large "dial bounce," making weighup scale readings difficult.

3. The weighup hopper air vent area is too small and inadequate.

4. The variable frequency drive supply for the Carrier screener drive motor is obsolete.

5. The controls are obsolete and not "user friendly".

6. Flooding of aluminum powder from the dump station through the screener into the weighup hopper is possible.

7. Insufficient clearance exists between the weigh hopper and the surrounding work platform, especially on the north side, for proper free movement of the hopper.

## 3.0 RECOMMENDATIONS

It is recommended that:

1. The Carrier vibrating screener be retuned by the vendor.

   Status - Completed, but still vibrates.

2. The power supply for the Carrier screener be replaced with more modern equipment.

   Status - Completed

   NOTE: A used Parametric variable frequency controller was installed.

3. Additional air vent area to the weigh hopper be installed.

   Status - Completed.

4. The controls be replaced with state-of-the-art computer-based controls.

5. The Carrier vibrating screener be replaced with a highly accurate screw feeder such as Accu-Rate or Acrison.

6. A shutoff valve be installed between the screener and the weigh hopper.

7. The clearance be enlarged between the weigh hopper and the flooring.

   Status - Completed.

## 4.0 NARRATIVE

One step in the RSRM propellant manufacturing process is to weigh and blend aluminum powder with HB polymer at the premix facility (M-120). Recently, difficulties have been experienced in maintaining the aluminum powder weights within tolerance which is ±2 pounds.

Process Engineering assisted Facilities Engineering, Manufacturing Engineering, and Manufacturing in evaluating the aluminum powder weighup system. The following items were noted:

1. The Carrier vibrating screener was vibrating excessively. This caused the whole weighup structure to vibrate and precluded accurate weighing.

2. The Carrier vibrating screener had no slow speed or dribble feed capability.

3. Venting of the weighup hopper was inadequate. This causes airflow to travel through the screener when aluminum was discharged into the mix bowls.

4. The variable frequency drive for the Carrier screener drive motor is obsolete. Repair parts are difficult to obtain.

5. Flooding of aluminum powder from the dump station through the screener into the weighup hopper is possible as there is no positive shut-off between the screener and weigh hopper.

6. The control console is obsolete, requiring constant operator attention and technique.

7. Three (3) different brands of scale readouts are used in this single console.

8. No set points are provided on any of the scale systems.

9. The clearance between the weigh hopper and the work platform was insufficient on the north side to ensure free movement of the weigh hopper. This clearance needs to be enlarged.

Some of the deficiencies were corrected in late December 1989, as follows:

1. Vendor tuning of the Carrier vibrating screener greatly reduced the vibration imparted to the weighup structure. The very large fluctuations in the digital readout during weighups were substantially reduced, making reading the target values easier.

2. A different brand (Parametrics) variable frequency drive was installed. This Parametrics power supply is a used item that was on hand, making for a quick changeover. During use, its durability will require monitoring by the user.

3. Three vent socks made from shortened dust collector bags were adapted to the weighup hopper's lid for additional venting. This additional venting proved to be adequate in later tests; however, their location may not be ideal. Additional evaluation of this location problem will be needed.

4. The clearance between the weigh hopper and floor was enlarged.

Testing conducted on 22 December 1989 showed that these changes were a considerable benefit as all 20 test runs were held within the ±2 pounds of target weight. One very interesting observation made during these 20 runs was the great disparity in the Carrier feeder feed times between a recently filled surge hopper and one that had two or more runs. With the system emptied and then fresh aluminum dumped into the surge hopper, the feed time for 1,000 pounds was only two to three minutes. Whereas, after two or three consecutive runs, the feed time became stabilized near 21 minutes. This is consistent and is a function of how rapidly the aluminum powder is debulked by vibration. Operators need to be aware of this condition.

Subsequent segment loadings showed that this weighup system has been improved, but not completely fixed. Each segment loading had between one and three aluminum powder weighings that exceeded the production tolerance of ±2 pounds. However, each was less than the propellant specification (STW5-3343A) allowable aluminum tolerance of ±7 pounds. This is a "use as is" discrepancy just requiring Manufacturing documentation.

While the above changes were beneficial, to complete the goal of ensuring accurate aluminum powder weighups at M-120, additional improvements are required, as follows:

1. A new control system that allows for presetting the desired weights and is user friendly.

2. Replacement of the Carrier vibrating screener with a highly accurate, reproducible screw feeder and SWECO-type screening device. Acrison and Accu-Rate are two firms that build such feeders.

3. Install a shut-off valve between the feeder and weighup hopper to prevent flooding when dumping aluminum powder into the surge hopper.